OMI NO_2 Validation

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SAOZ
D Ionov
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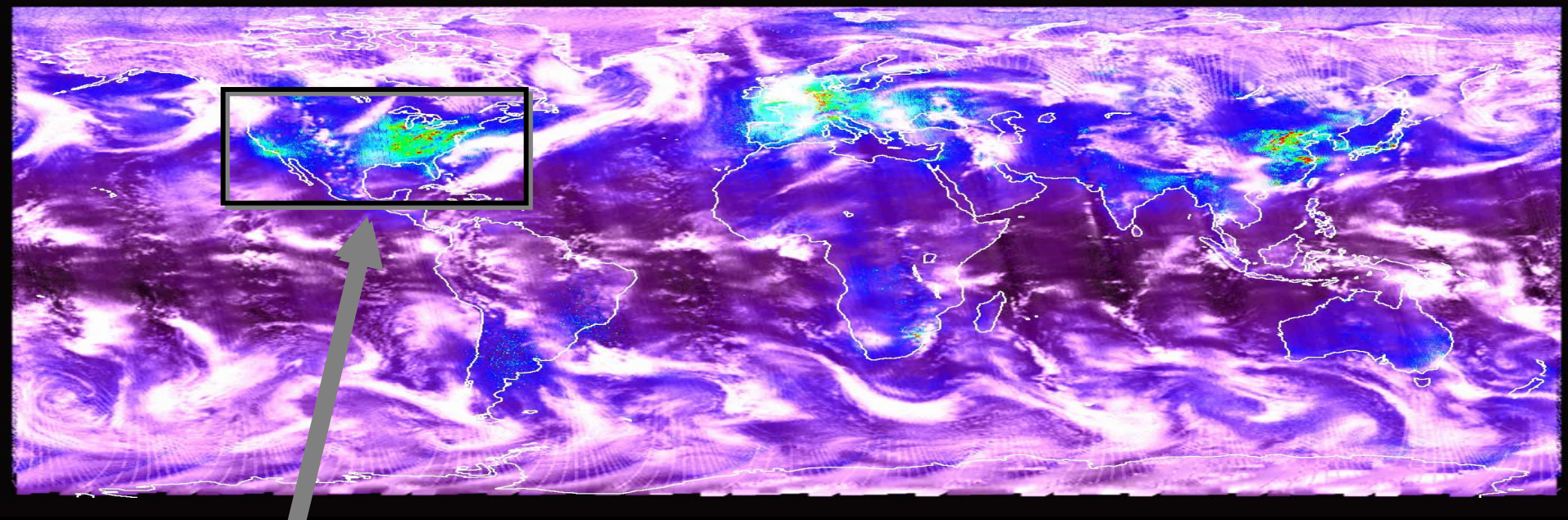
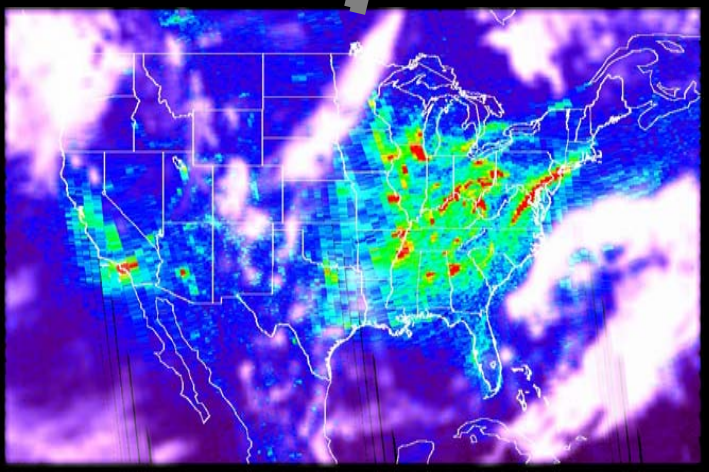
Max DOAS
G Mount
E Spinei
M V Roozendael

Aircraft Profiles
T Bertram
A Perring
R Cohen

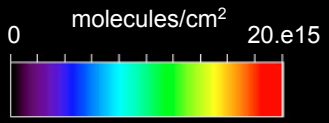
Direct Sun
S Sander
J Herman
A Cede

OMI NO_2 Meets Schoeberl Criteria





OMI NO_2 Images for April 15, 2005



Schoeberl Criteria: Looks like the right planet.

OMI Total Column NO_2

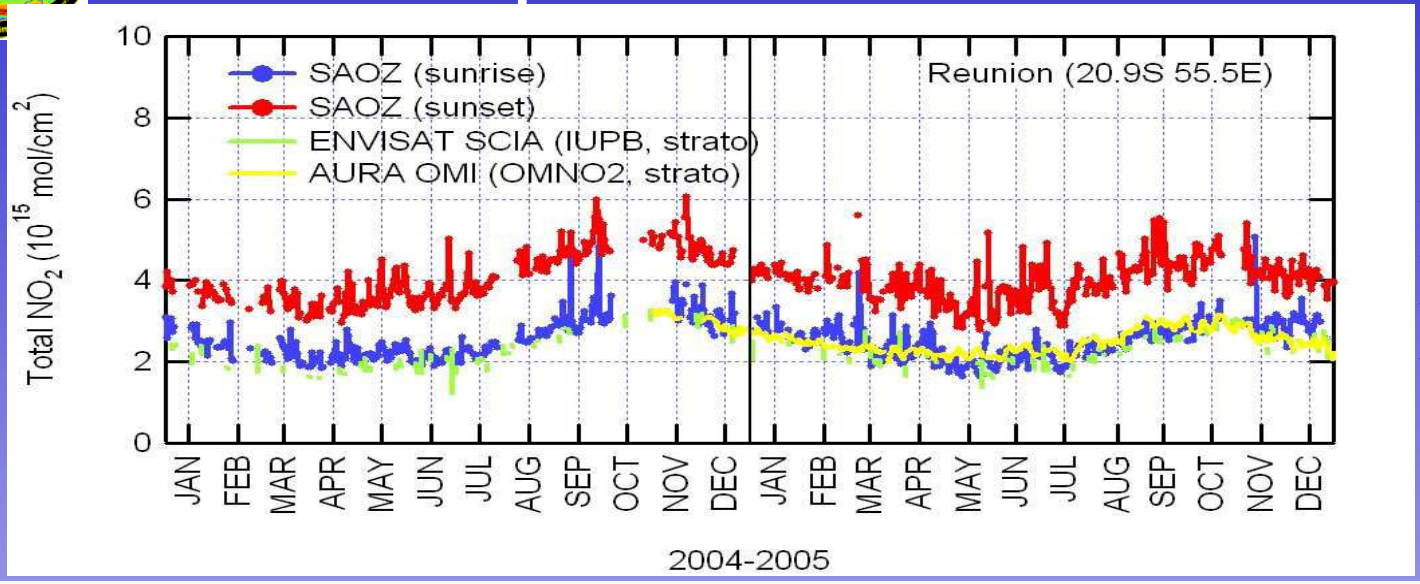
Case 1: Over remote areas (most of the globe)

- Total column NO_2 is dominated by stratospheric NO_2.
- Retrieval is straightforward, minimum of *a-priori* information

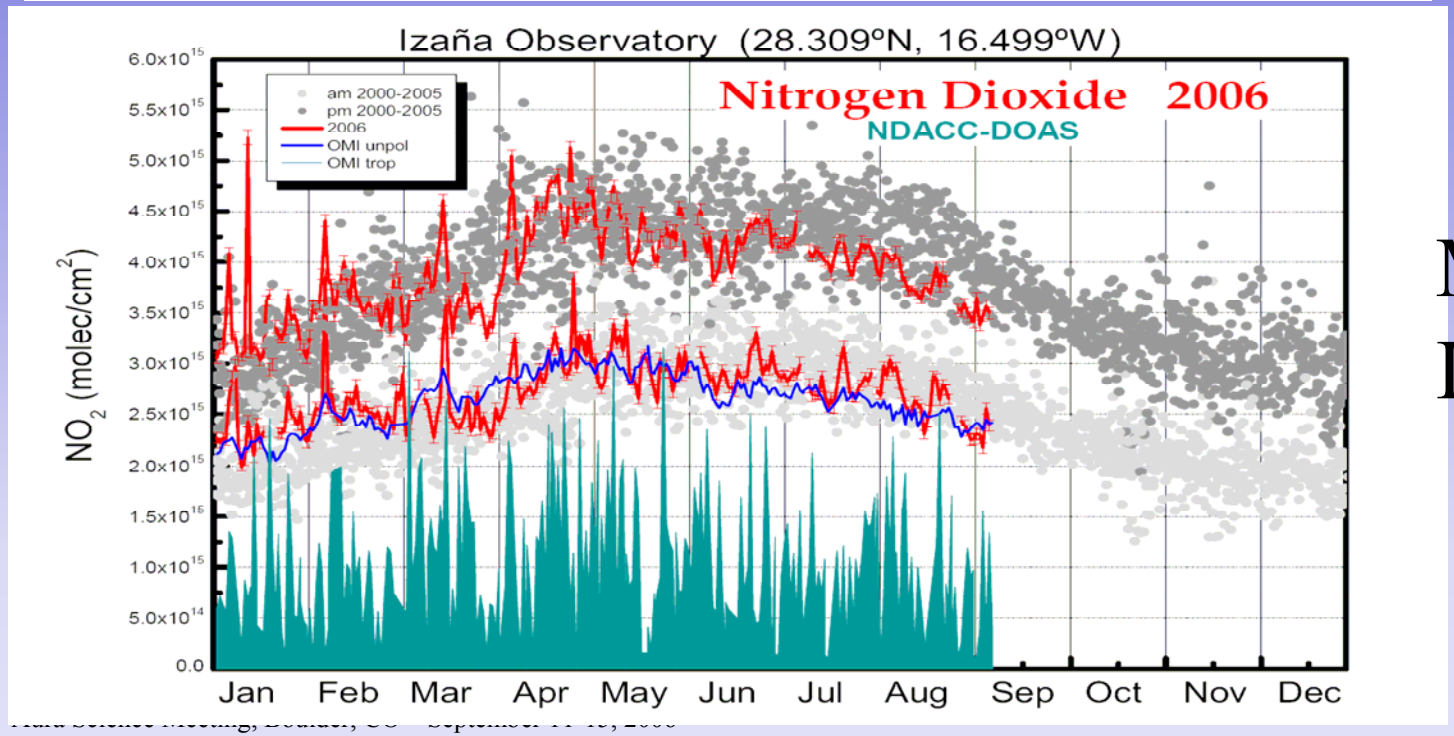
Case 2: Over populated areas (interesting parts)

- Total column is dominated by tropospheric NO_2
- Requires troposphere – stratosphere separation
- Retrieval is complicated, Requires *a-priori* information on profile shape, surface albedo, aerosols
- Tropospheric Column NO_2 product

Sub-Tropical SOAZ and OMI

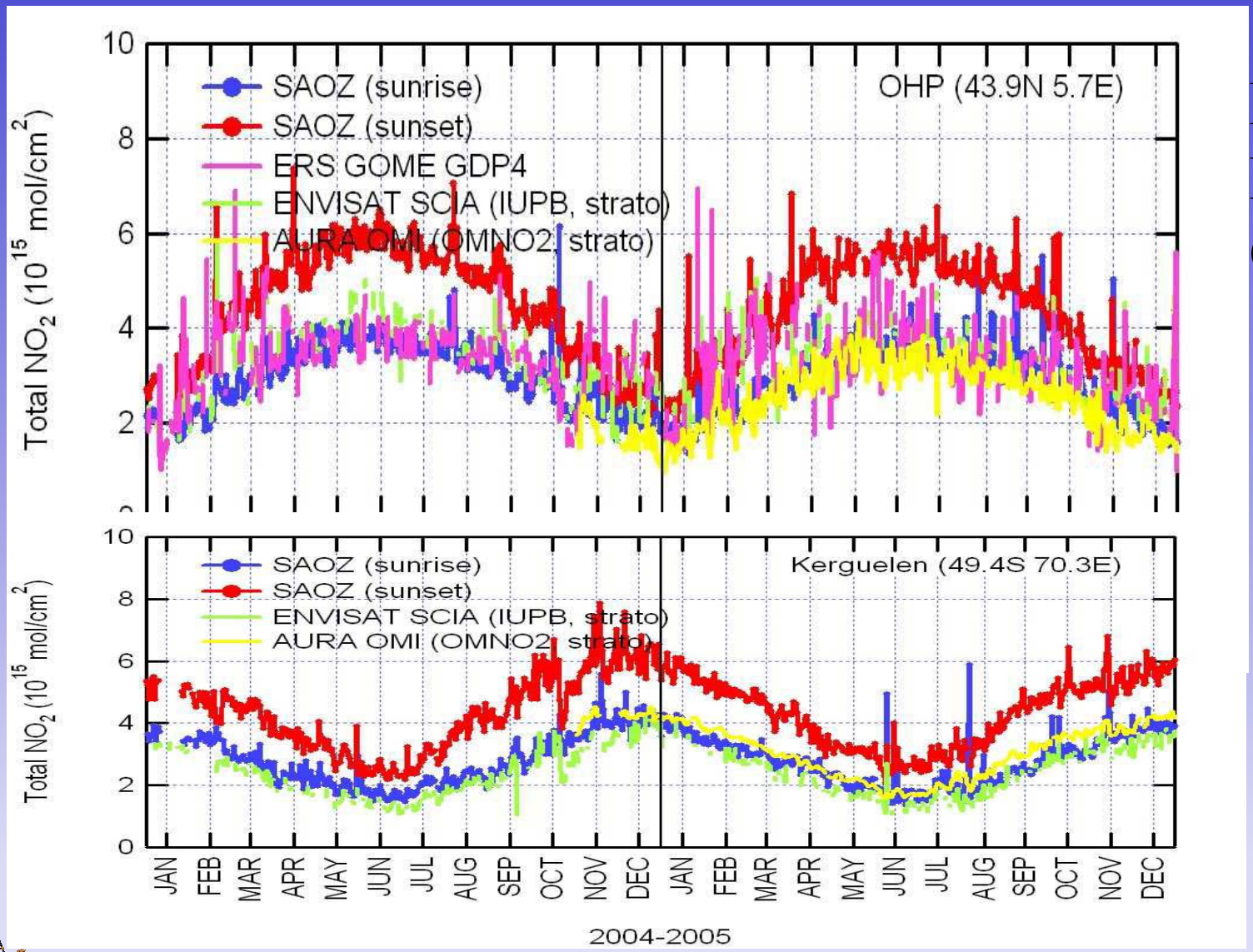


D Ionov
F Goutail
CNRS



M Gil
INTA

Mid-Latitude SOAZ and OMI



D Ionov
F Goutail
CNRS

NO_2 Validation

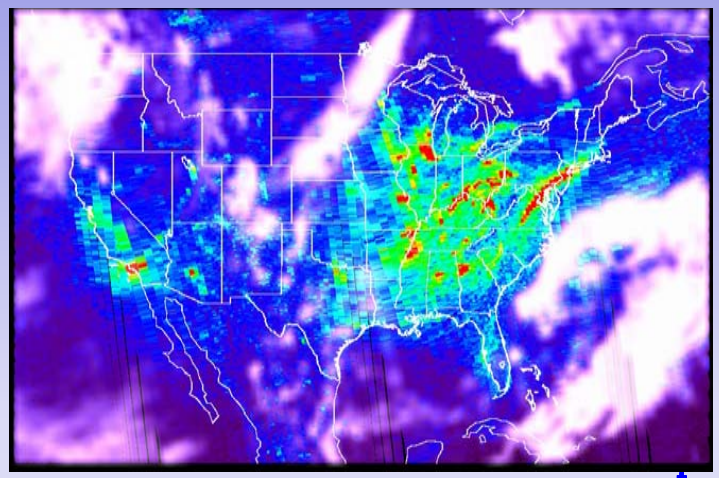
Case 1, Summary: Good agreement (+/- 10%) with sunrise SAOZ data over a range of latitudes, excellent temporal correlation

Case 2: Large Tropospheric NO_2

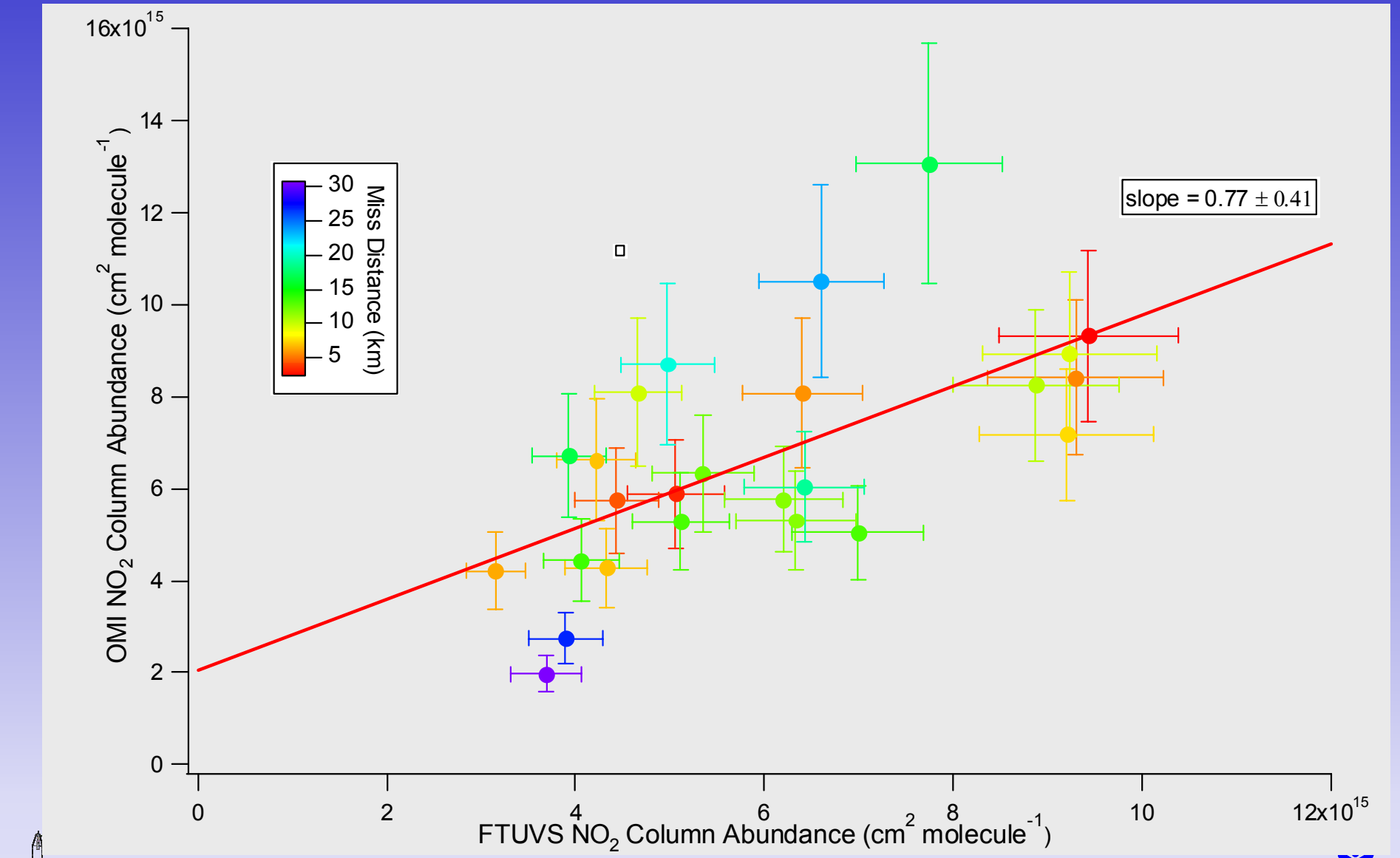
Ground-based Direct Sun

Indicate 30-50% OMI

Underestimation of trop NO_2

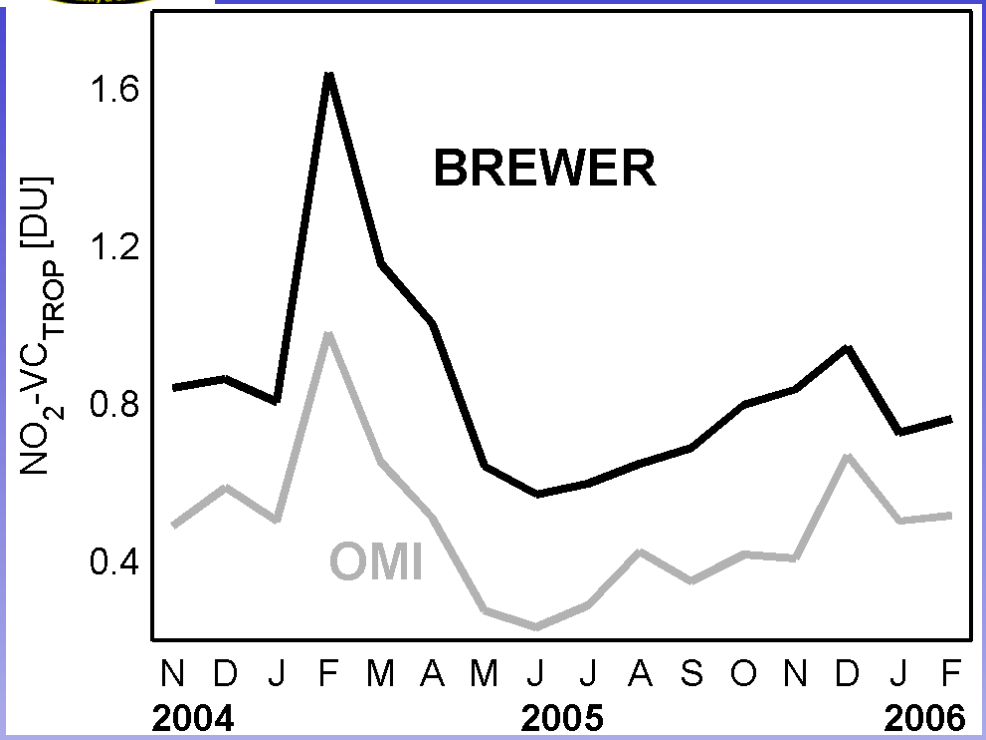


NO_2: OMI vs. FTUVS - Binned by Distance between TMF and Centroid of OMI Footprint

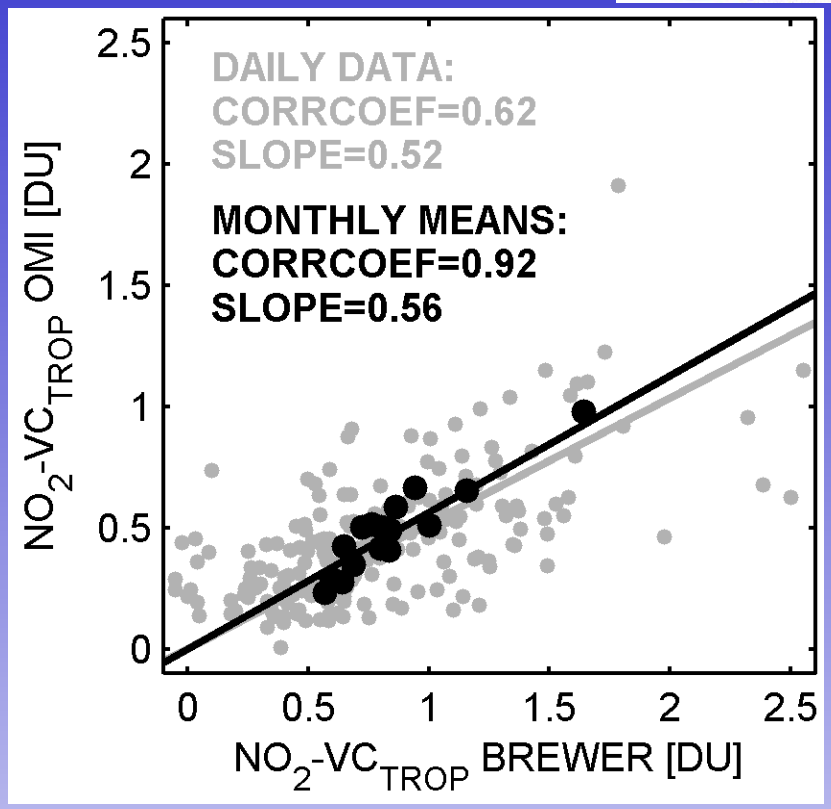


Data from Stan Sander JPL

NO_2 Tropospheric column OMI vs. Brewer



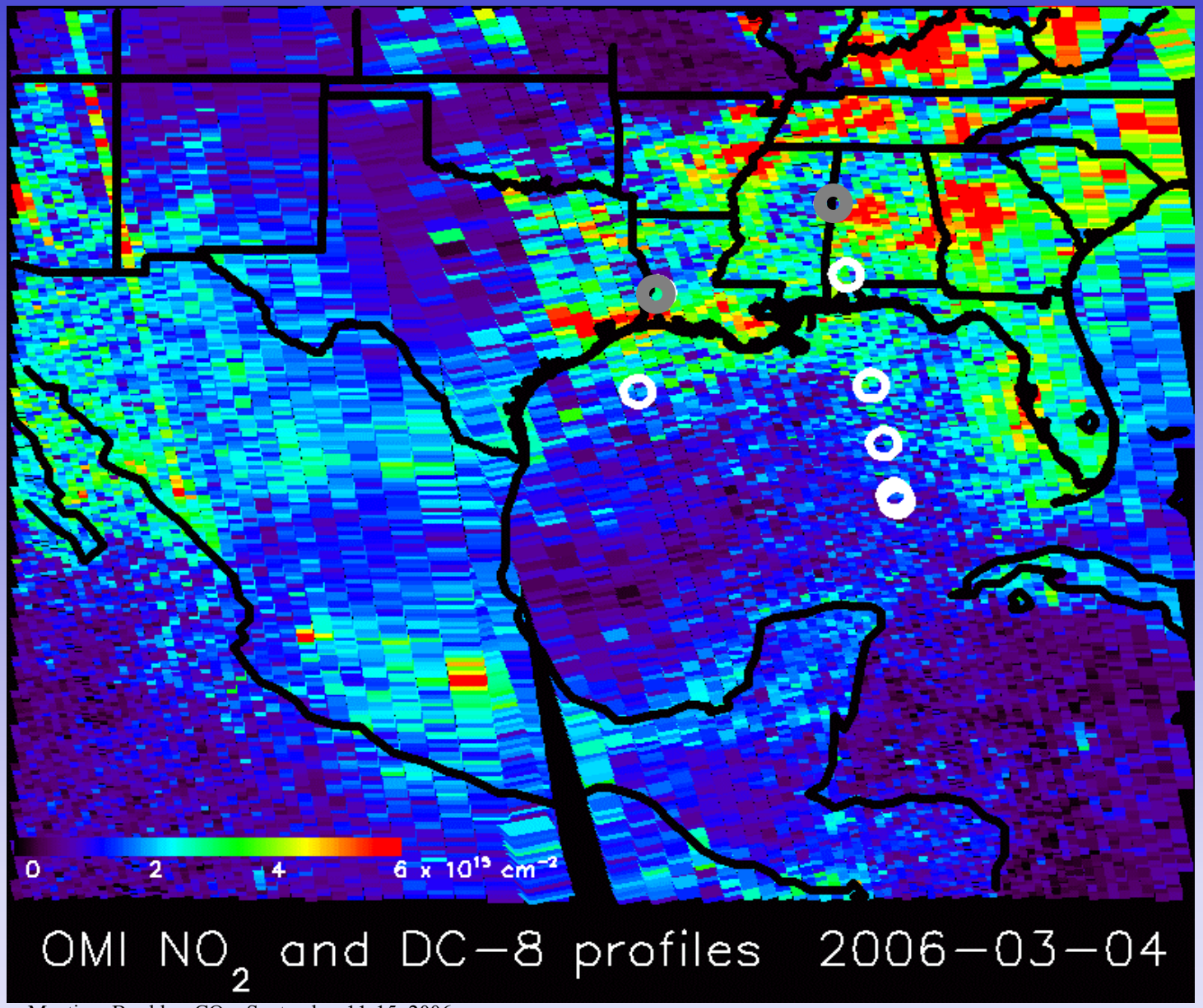
Monthly mean Tropospheric NO2 columns at Goddard Space Flight Center. Brewer direct sun data (black) are temporal averages over a 2 hour window around OMI overpass time and are cloud screened. OMI data (gray) are spatial averages over all pixels, which center within 25km around the ground location, and only cloud fractions below 25% are used.



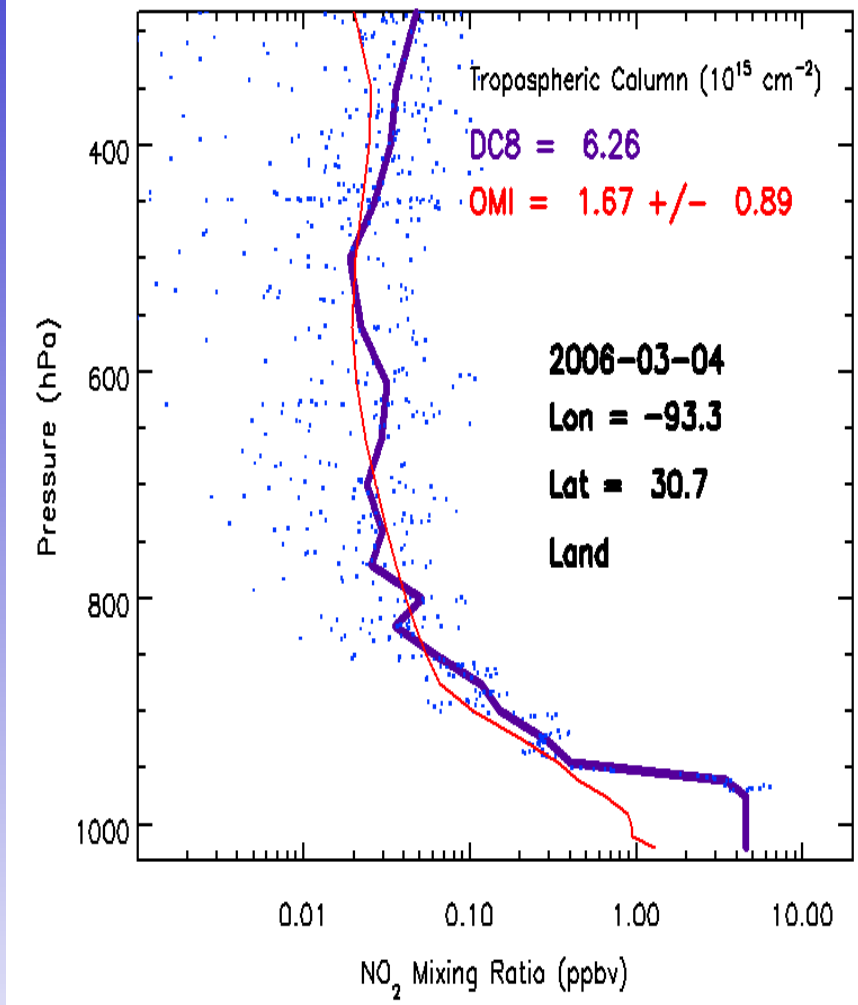
Black dots are same data as in left figure. Gray dots are 205 daily data. Lines are linear least square fits in the data, forced through the origin.

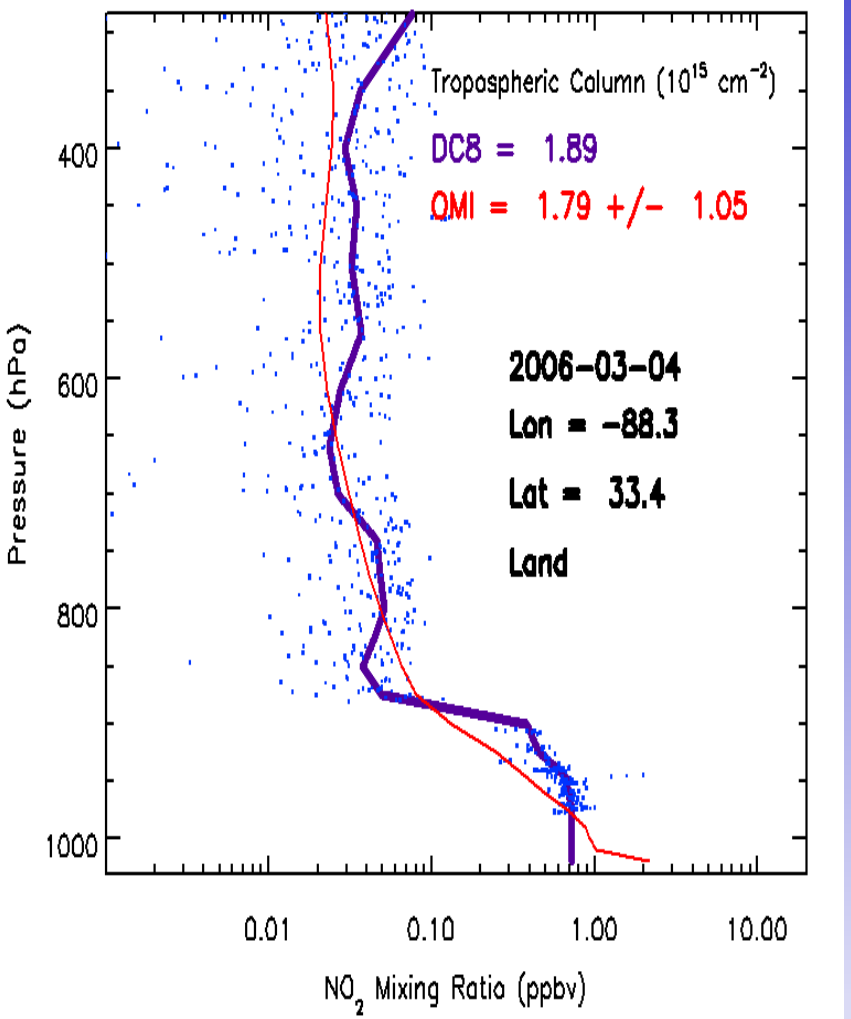
Data from Jay Herman & Alexander Cede GSFC

March 4 OMI tropospheric NO_2 and locations of INTEX-B DC-8 profile measurements



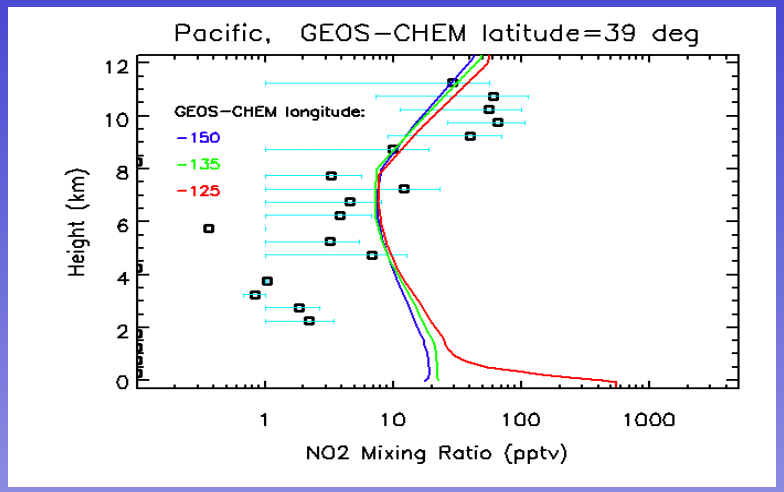
DC-8 NO_2 land profiles 2006 March and OMI comparison



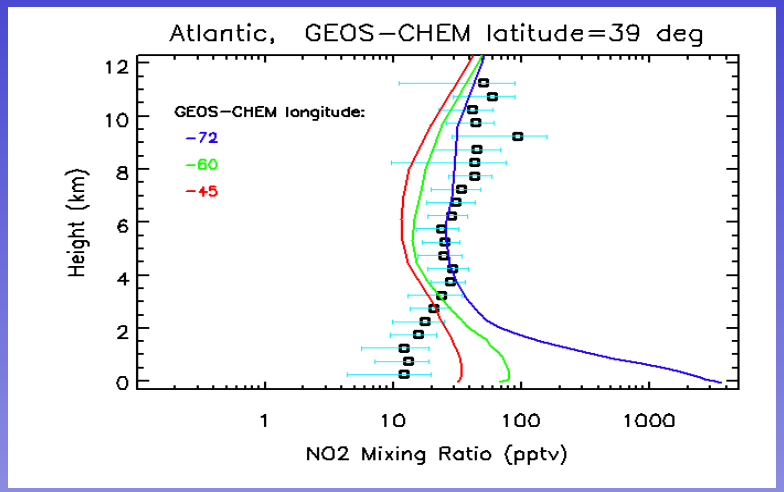


DC8 Data from Ron Cohen UCB

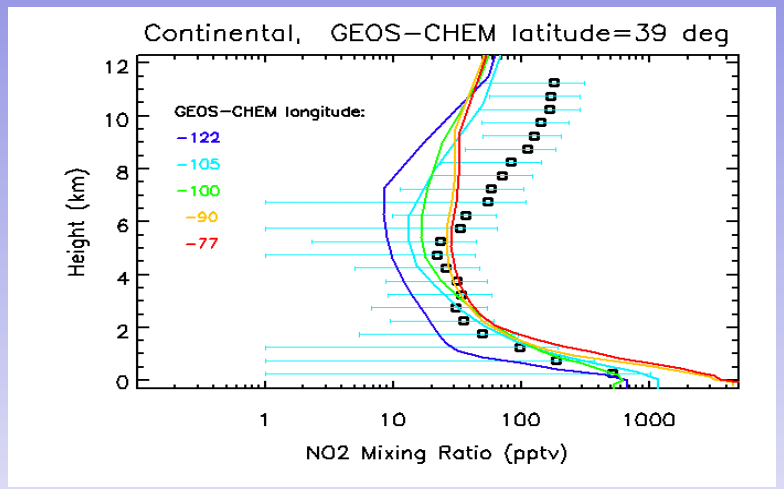
Tropospheric NO_2 profiles: Data & GEOS-CHEM Model



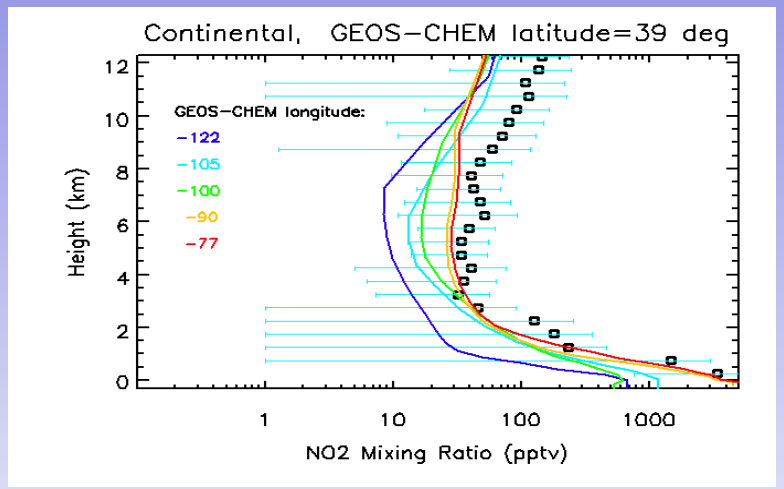
INTEX-NA Pacific and model profiles



INTEX-NA Atlantic and model profiles

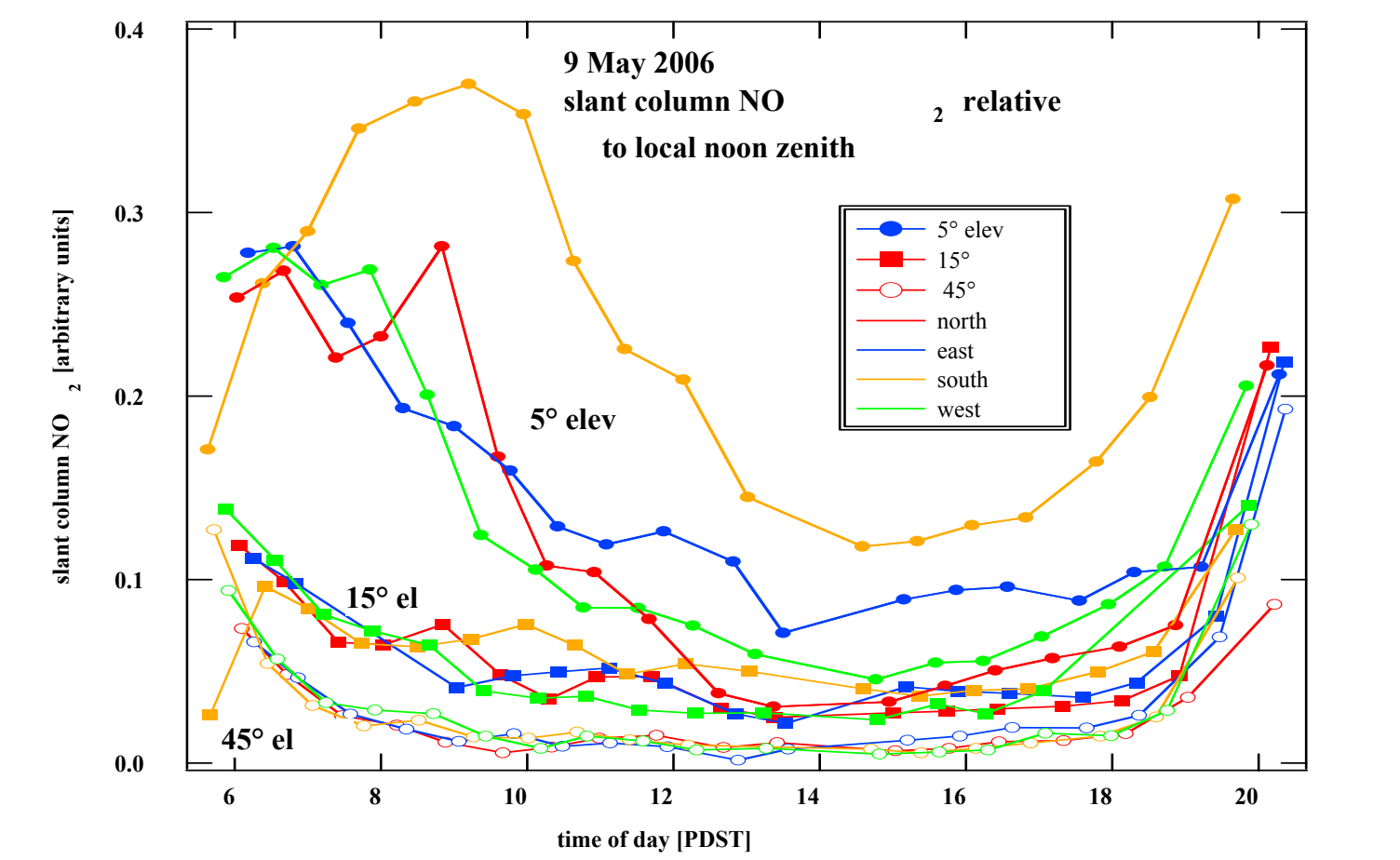


INTEX-NA continental and model profiles



PAVE continental and model profiles

Inhomogeneous NO_2



Data from G Mount E Spinei WSU

- instrument location: north of the city
- a main highway runs N-S nearby
- in situ meas. show an AM pollution plume that lasts about 3-4 h
- in situ meas. show only a small PM pollution plume

- field of view direction
  - azimuths color coded
  - elevation angles symbol coded
- angles chosen to match Chance (2005)
- vertical scale is prop to NO_2 slant col.

OMI Total Column NO_2

Case 1: Summary

Good agreement (+/- 10-15%) with sunrise SAOZ data over a range of latitudes, excellent temporal correlation

Case 2: Summary

Ground-based Direct Sun indicate 30-50% OMI underestimation of trop NO_2 with good temporal correlation.

Investigating sources of systematic errors

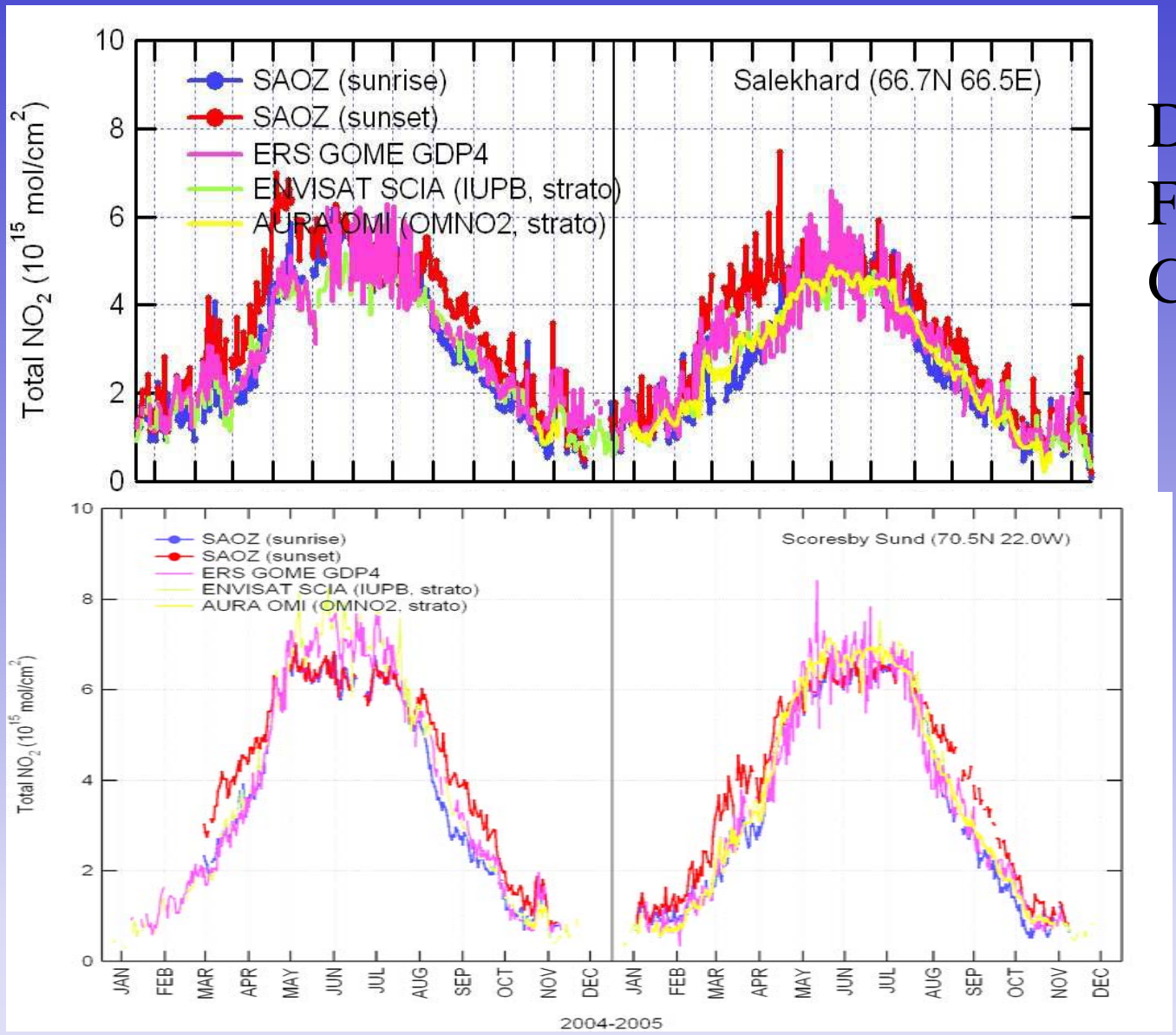
- profile shape
- surface albedo
- aerosols

Needs: More Profiles, More Direct Sun Measurements, Simultaneous aerosol measurements

Version 2 Reprocessing after new L1b Spring '07

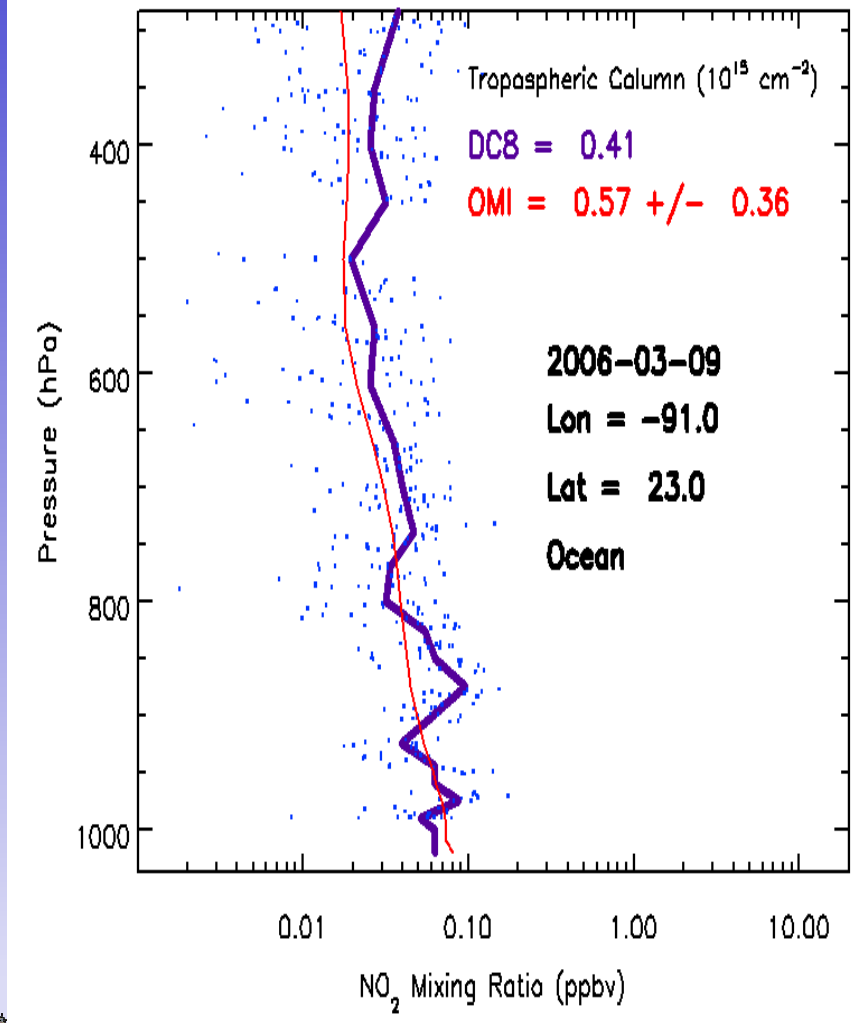
Questions

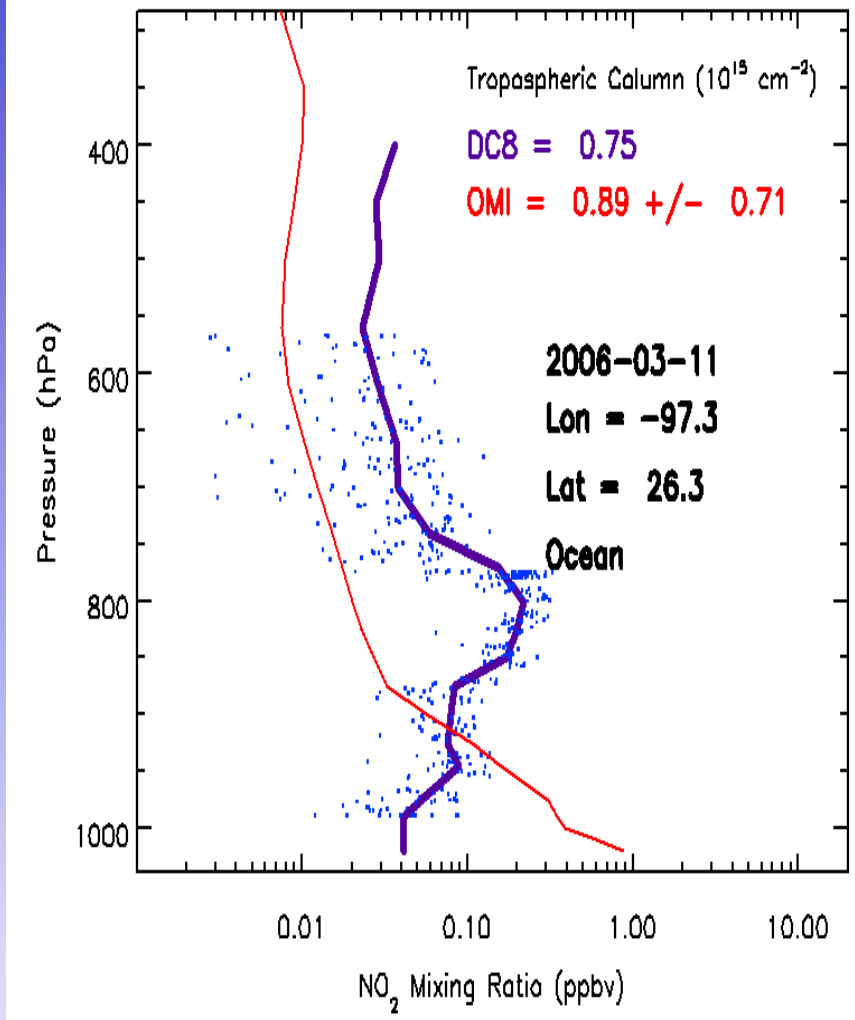
High-Latitude SOAZ and OMI



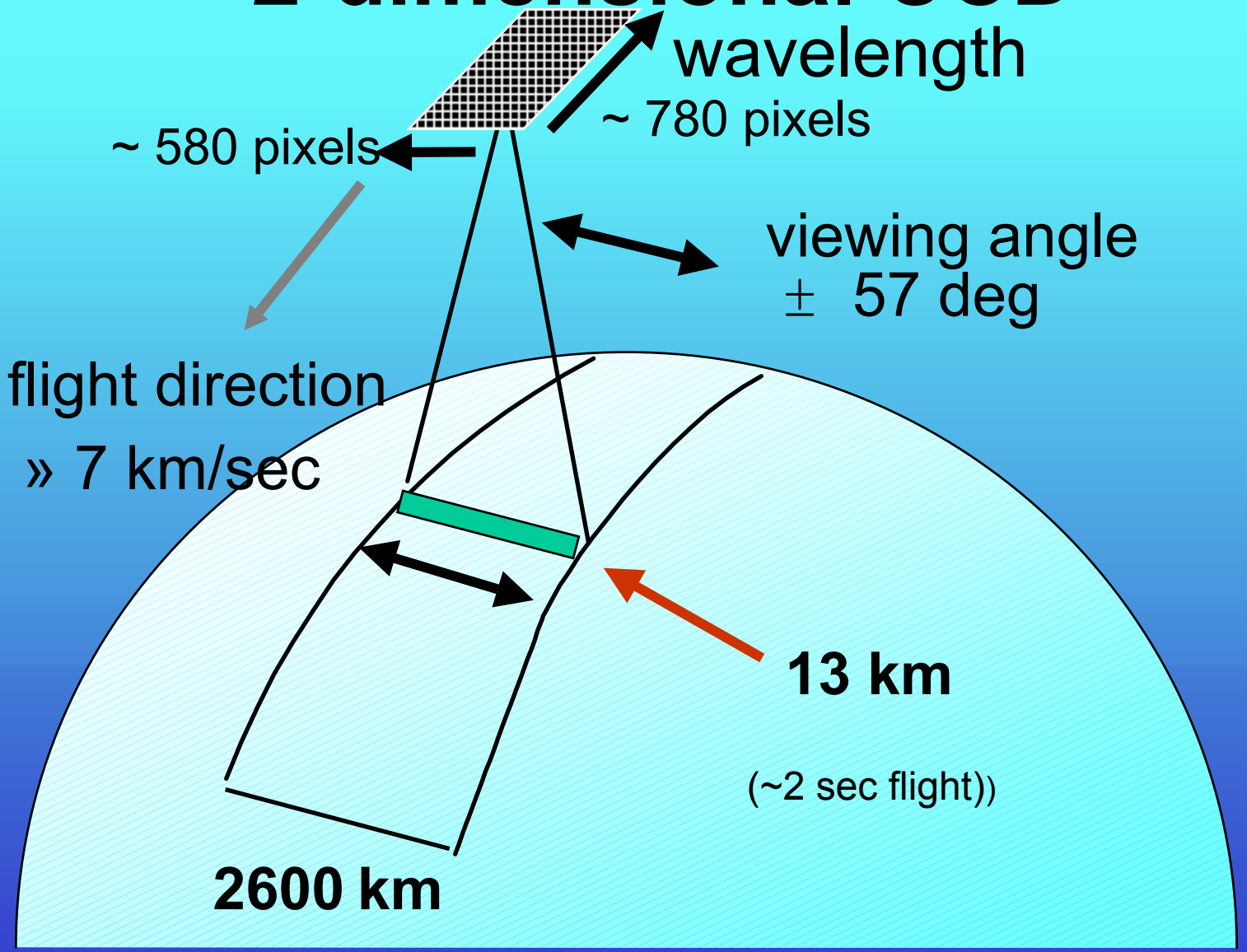
D Ionov
F Goutail
CNRS

DC-8 NO_2 ocean profiles 2006 March and OMI comparison



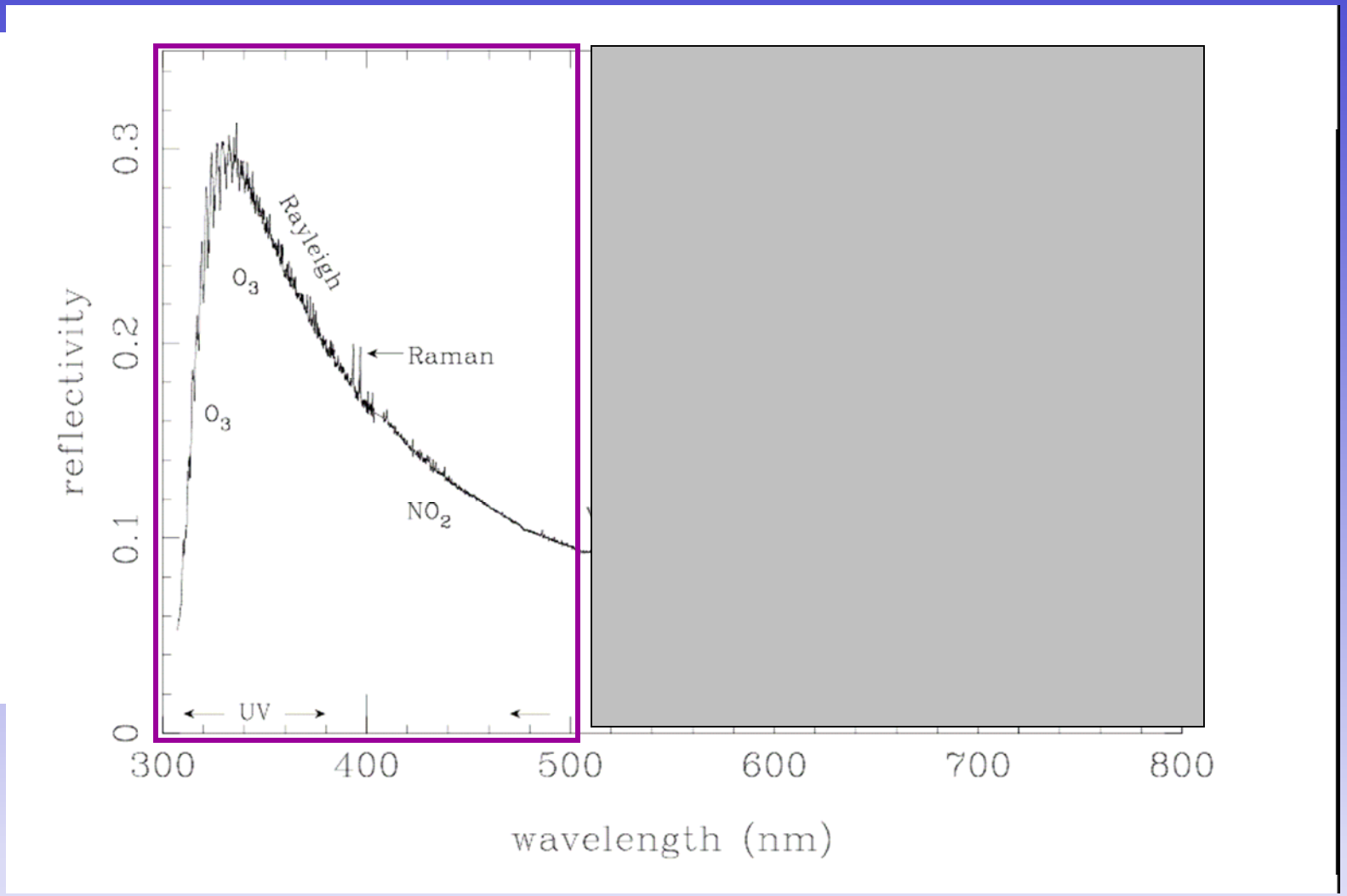


2-dimensional CCD



12 km/24 km (binned & co-added)

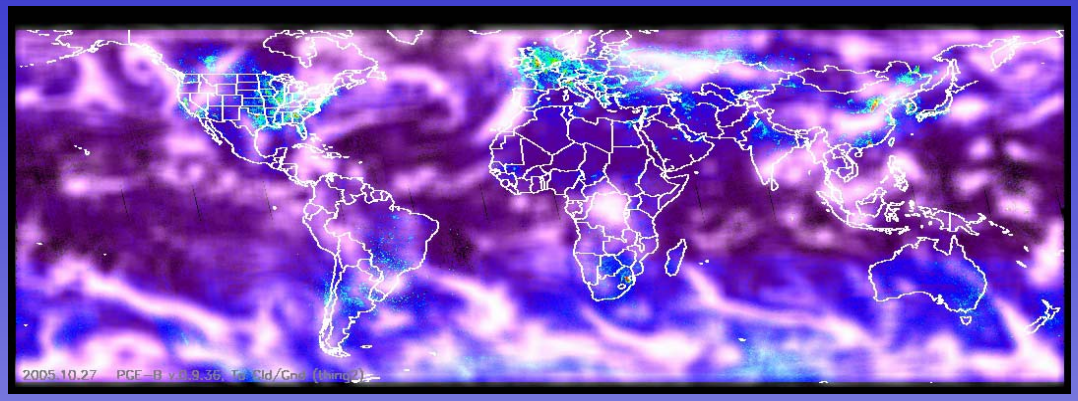
OMI Spectral Range



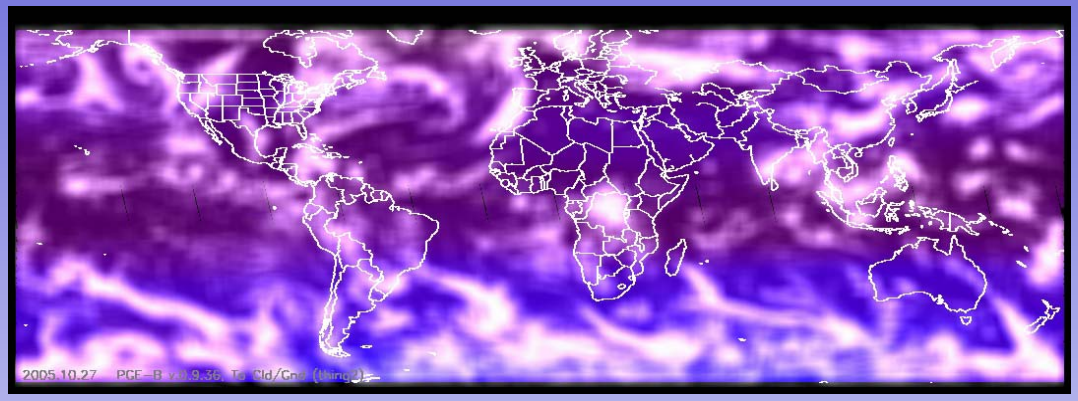
OMI NO_2 algorithm summary

- Fit spectra to obtain slant column densities (SCDs) and obtain an initial vertical column density field, assuming a stratospheric AMF.
- Mask out tropospheric "hot spots" and geographically smooth the remaining global NO_2 field to get an approximation of stratospheric NO_2.
- Subtract the stratospheric field from the initial field. The largest differences will appear at the hot spots.
- Apply a tropospheric AMF to the residuals to get the tropospheric NO_2 amount (AMFs are calculate *a priori* from a gridded time-independent set of NO_2 profiles).

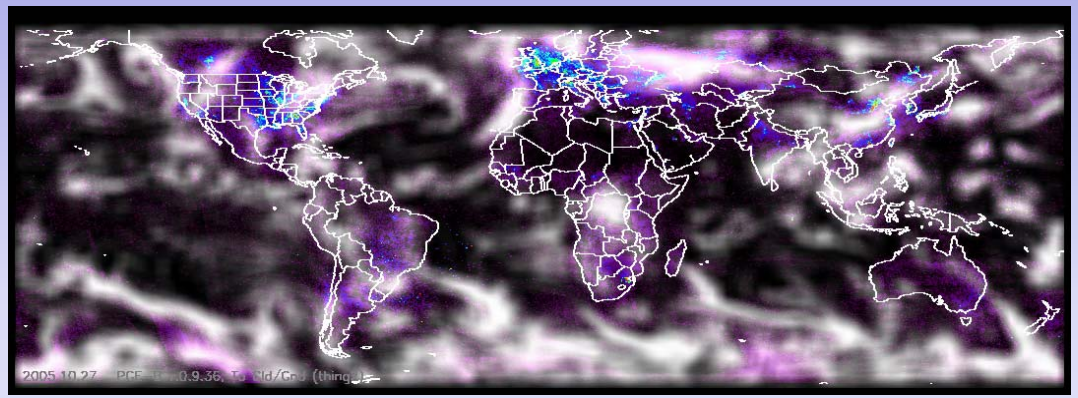
OMI NO2 Algorithm Steps



Initial

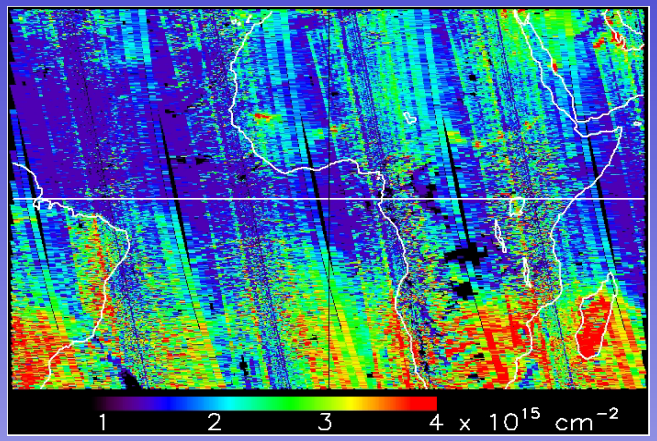


Smooth

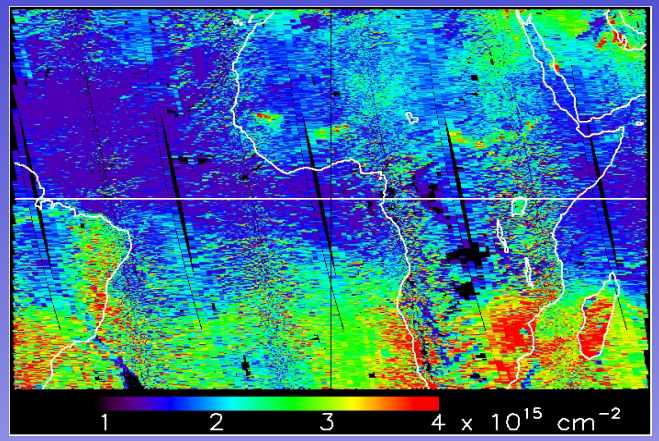


Trop

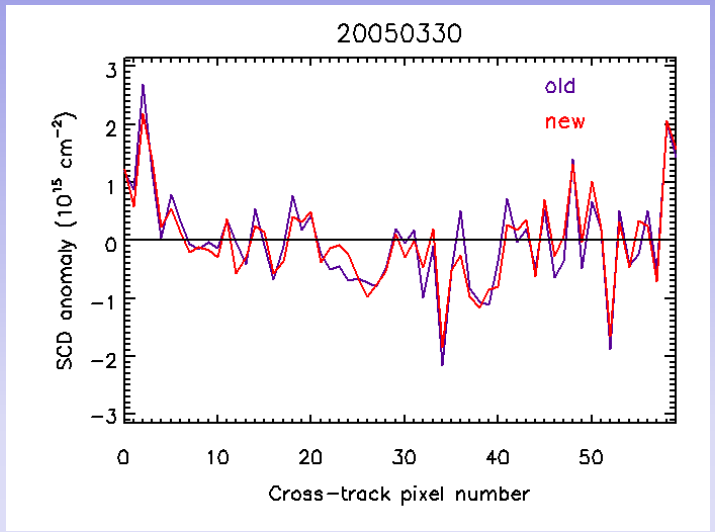
OMI Cross track Bias



NO_2 VCD (uncorrected)



NO_2 VCD (corrected)

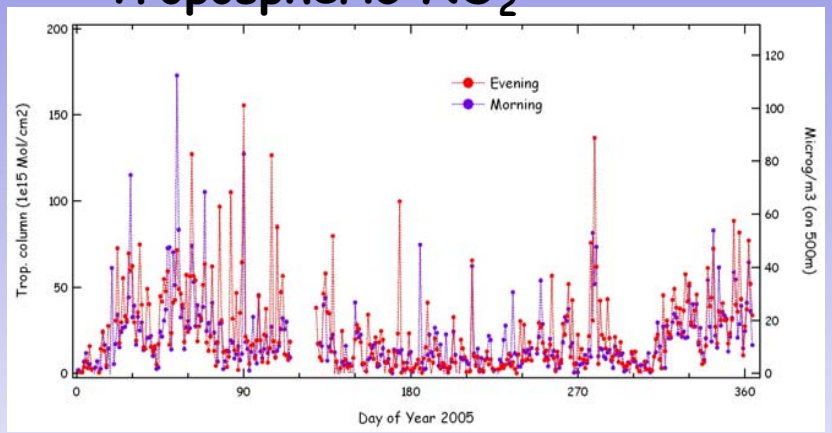


NO_2 pollution monitoring above Paris using SAOZ measurments (1)

F. Goutail, F. Borchi, A. Bazureau, D. Ionov, J. Abadie, M. Valamanesh Service d'Aéronomie CNRS/IPSL, F. Meleux, INERIS

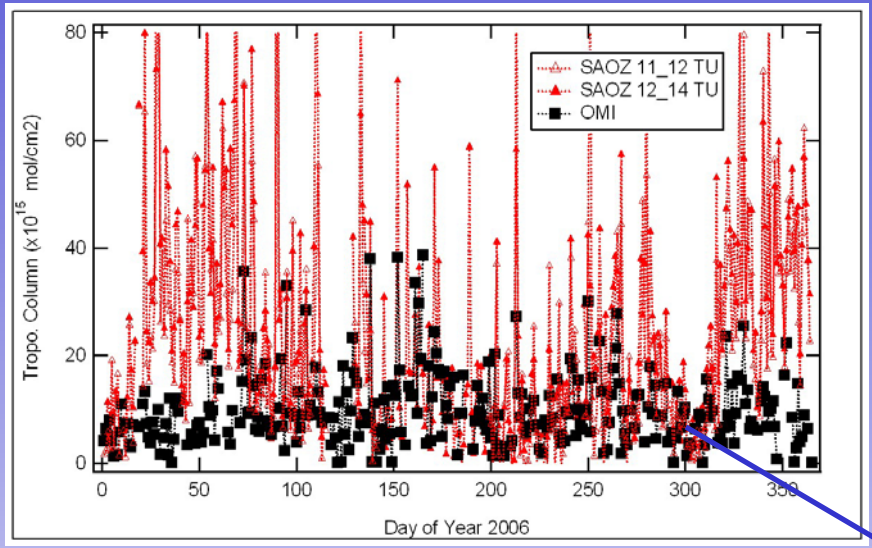
Uv-visible zenith sky spectrometer, 300-600nm, O_3, NO_2, located inside Paris (on the roof of Univ.)

Tropospheric NO_2

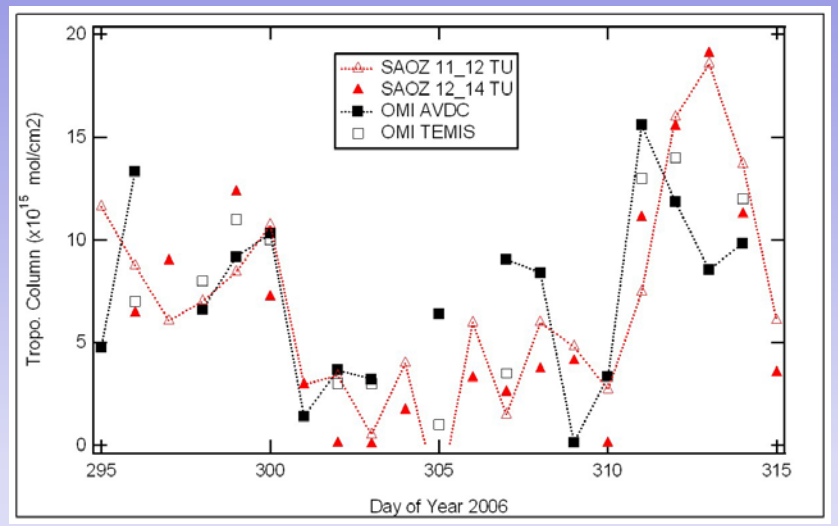


Tropospheric NO_2 calculated from **total column NO_2** minus **stratospheric NO_2** (strat. NO_2 from OHP clean air station in southern France). Validated using Airparif in-situ data.

NO_2 pollution monitoring above Paris using SAOZ measurments (2)



One year of comparison:
There are periods with very good agreement and periods with underestimation by OMI.



Zoom on period after October 23, 2005:
2 sets of OMI data:
- AVDC (Tropospheric NO2)
- TEMIS (from the plots on website)